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Reconstruction of Vertical Profile of Permittivity of Layered Media which is Probed Using Vertical Differential Antenna

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Results of this research are intended to use at GPR investigations of layered media (for example, at roads' inspection) for the processing of collected data and reconstruction of dependence of permittivity on the depth.
Recently, an antenna system with a vertical differential configuration of receiving module (Patent UA81652) for GPR was suggested and developed The main advantage of the differential antennas in comparison with bistatic antennas is a high electromagnetic decoupling between the transmitting and receiving modules. The new vertical differential configuration has an additional advantage because it allows collecting GPR data reflected by layered media without any losses of information about these layers [1] and, potentially, it is a more accurate instrument for the layers thickness measurements [2]. The developed antenna system is tested in practice with the GPR at asphalt thickness measurements [3] and shown an accuracy which is better than 0.5 cm. Since this antenna system is good for sounding from above the surface (air coupled technique), the mobile laboratory was equipped with the developed GPR [3].
In order to process big set of GPR data that collected during probing at long routes of the roads, for the data processing it was tested new algorithm of the inverse problem solution. It uses a fast algorithm for calculation of electromagnetic wave diffraction by non-uniform anisotropic layers [4]. The algorithm is based on constructing a special case solution to the Riccati equation for the Cauchy problem and enables a qualitative description of the wave diffraction by the electromagnetic structure of the type within a unitary framework.
At this stage as initial data we used synthetic GPR data that were obtained as results of the FDTD simulation of the problem of UWB electromagnetic impulse diffraction on layered media. Differential and bistatic antenna configurations were tested at several different profiles of permittivity. Meanings of permittivity of each of layers were reconstructed successfully. Corresponding results are given in the presentation.

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